Swami Ramanand Teerth Marathwada University,

Vishnupuri, Nanded. (Maharashtra), India.

M.A. /M. Sc.
(Mathematics)
Syllabus
Semester-II
(For Campus School)

Swami Ramanand Teerth Marathwada University, Nanded.
SCHOOL OF MATHEMATICAL SCIENCES

M.Sc. (Mathematics)-I year

SEMESTER-II	
Paper No.	**Name of the paper**
MTU-201	Linear Algebra
MTU-202	Real Analysis-II
MTU-203	Topology
MTU-204	Elementary Number Theory
Any one of the following MTU-205(A) to MTU-205(C) **which will be taught in the School**	
MTU-205(A)	Differential Equations
MTU-205(B)	Differential Geometry of Manifolds- II
MTU-205(C)	Dynamics and continuum Mechanics-II
MTU-206 (Compulsory to all the students)	**Lab Course-II** Software Scilab and Practicals in Linear algebra, Number Theory, Analysis

(For entire course structure and evaluation strategy, one may visit page number 6, from syllabus of M.Sc. (Mathematics)-I sem)

MTU -201: Linear Algebra

(Maximum Number of Periods: 60)

Unit 1: ***(Pre-requisites)****:*

Basic theory of fields, Field extension, Examples, matrices, determinants, polynomials.

Unit 2: ***Vector spaces:***

Introduction, Vector spaces, subspaces, Linear combinations and system of linear equations, linear dependence and independence, Bases and dimension, Maximal Linear Independent Subsets.

Unit 3: ***Linear Transformations and Matrices:***

Linear Transformations, Null spaces, and ranges, the matrix representation of a linear transformation, Composition of linear transformations, Invertibility and Isomorphisms, The change of Coordinate matrix, Dual spaces, and Homogeneous linear Differential equations with constant coefficients.

Unit 4: ***Elementary Matrix Operations and system of linear equations (Revision):***

Elementary Matrix Operations and elementary matrices, the rank of a matrix, System of linear equations-Theoretical Aspects, System of linear equations-Computational Aspects.

Unit 5: ***Diagonalization:***

Eigen values and eigen vectors, Diagonalizabity, Invariant Subspaces and the

Cayley-Hamilton Theorem.

Unit 6: ***Inner Product Spaces:***

Inner products and Norms, The Gram-Schmidt orthogonalization process and orthogonal complements, the adjoint of a linear operator, Normal and self-adjoint operators, Unitary and orthogonal operators and their matrices, orthogonal projections and the spectral theorem, Quadratic forms.

Unit 7: ***Canonical Forms:***

Jordan Canonical form I, Jordan Canonical form II, The minimal polynomial, Rational Canonical form.

Text Book: S.H.Friedberg, A.J.Insel, L.E.Spence: Linear Algebra, Prentice-Hall International, Inc., 3rd Edition.

Scope: Ch 1: Art.1.1 to 1.7, Ch 2:Art. 2.1 to 2.7, Ch 3:Art 3.1 to 3.4, Ch 5: Art 5.1,5.2,5.4, Ch 6:Art 6.1 to 6.7, Ch 7 : Art 7.1 to 7.4 .

Reference Books:

1. Vivek Sahai, Vikas Bist: Linear Algebra, Narosa Publishing House, 2nd Edition.
2. I. N. Herstein, "Topics in Algebra", Macmillan, Indian Edition.
3. S.Lang:Introduction to Linear algebra,Springer International Edition,2nd Edition.
4. K.Hoffman,R.Kunze: Linear Algebra. Prentice Hall of India.
5. J.H.Kwak, S.Hong: Linear Algebra, Birkhäuser Verlag, 2nd Edition.
6. Harvey E.Rose:Linear Algebra.A pure Mathematical Approach, Birkhäuser Verlag.

MTU-202: REAL ANALYSIS –II

(Maximum Number of Periods: 60)

Unit 1: (Pre-requisites):

Algebra of sets, The axiom of choice and infinite direct products, Open and closed sets of real numbers, continuous functions, Borel sets.

Unit 2: Lebesgue measure:

Introduction,outer measure, measurable sets and Lebesgue measure, a nonmeasurable set, Measurable functions, Littlewood's three principles.

Unit 3: The Lebesgue integral:

The Riemann integral, The Lebesgue integral of a bounded function over a set of finite measure, The integral of a nonnegative function, The general Lebesgue integral, convergence in measure.

Unit 4 : Differentiation and integration :

Differentiation of monotone functions, functions of bounded variation, differentiation of an integral, absolute continuity, convex functions.

Unit 5 : Classical Banach spaces:

The L^p spaces, The Minkowski and H*ö*lder inequalities, convergence and completeness. Approximation in L^p .

Unit 6 : Measure and Integration:

Measure spaces, Measurable functions, Integration, General Convergence Theorems, Signed measures, The Radon-Nikodym Theorem, The L^p spaces.

Text Book: - H. L. Royden: Real Analysis, 3rd Edition, PHI Learning Private Ltd.
Scope: - Chapter 1: Art.4 & 5, Chapter 2: Art.5,6 & 7,Chapter 3: Art.1 to 6,Chapter 4: Art.1 to 5,Chapter 5: Art.1 to 5,Chapter 6: Art.1 to 5, Chapter 11: Art.1 to 7.
Reference Books:

i) N.L. Carothers, “Real Analysis”, Cambridge university press.
ii) P.R. Halmos: Measure theory, Narosa Publishing House.
iii) Inder K.Rana : An Introduction to measure and Integration.
Norosa publishing House ,Delhi : 1997.
iv) G. de. Barra; Measure theory and Integration,
v) P.K. Jain and V.P Gupta : Lebesgue measure and Integrtion
New age international (P) ltd publishing, New Delhi (Reprint 2000.)

MTU-203: TOPOLOGY

(Maximum Number of Periods: 60)

Unit 1 :(Prerequisites):

Topological Spaces, Basis for Topology,

Unit 2: The Order Topology, The product Topology, The Subspace Topology , Closed Sets and Limit Points ,Continuous functions , The Metric Topology.

Unit 3: Connectedness

Connected Spaces, Connected Subspace on Real Line,

Unit 4: Compactness

Compact Spaces, Compact Subspace on the Real Line, Limit Point Compactness, Local Compactness.

Unit 5: Countability and Separation Axioms

The Countailibity Axioms, the Separation Axioms, Normal Spaces, the Urysohn's Lemma,

The Urysohan Metrization Theorem, the Tietze Extension Theorem, the Tychonoff Theorem.

. ***Text Book:***

James R. Munkres: Topology, A first course, Prentice Hall of India. Pvt. Ltd. New Delhi-2000.

Scope:-

Chapter 2: Articles 12 to 20

Chapter 3 : Articles 23, 24, 26, 27,28, 29

Chapter 4: Articles 30 to 35.

Chapter 5: Articles 37

Reference Books:

i] J. Dugundji Allya and Bacon. Topology, (1966) reprinted: Prentice Hall of India.

ii] W. J. Pervin: Foundations of general topology, academic press Inc. N.Y. Hi] S. T.Hu: Elements of general topology. Holden day Inc. 1965.

iii] Stephen Willard, "General Topology", Addison-Wesley Publishing Company, 1970

iv] Sheldon W. Davis, Topology (The Walter Rudin Student Series in Advanced Mathematics), TATA McGraw-Hill.2006.

MTU-204: Elementary Number Theory

(Maximum Number of Periods: 60)

Unit 1 : **Divisibility Theory in the Integers**

Division Algorithm, the Greatest common Divisor, The Euclidean Algorithm, The Diophantine Equations $ax+by = c$, Fundamental Theorem of Arithmetic,

Unit 2: **Theory of Congruences**

Basic Properties of Congruences, Binary and Decimal Representations of Integers, Linear congruence and the Chinese Remainder Theorem.

Unit 3: Fermat Theorem

Fermat Little theorem and Pseudo primes, Wilson's Theorem, The Farmat –Kraitchik Factorization Method , The Equation $x^2+y^2= z^2$, Fermat's last Theorem.

Unit 4 :**Euler's Generalization of Fermat's Theorem**

Sum and Number of divisors, The Mobius Inversion Formula, The greatest Integer function, Euler's Phi- Function, Euler's theorem, Properties of Phi function.

Unit 5: **Primitive Roots, Indices and the Quadratic Reciprocity Law**

The Order of an Integer Modulo n , Primitive Roots for Primes , Composite Numbers having primitive Roots, Theory of Indices, Euler's Criterion , The Legendre Symbol and its Properties , Quadratic Congruences with Composite Moduli .

Text Book : Elementary Number Theory, By David M. Burton .Tata McGRAW-HILL,2006,

Scope : Chapter 2 to Chapter 9,

Reference Books :

1.A Baker**,** A concise Introduction to the Theory of Numbers, Cambridge University Press 1984

2. J.P. Serre, A course in arithmetic-. GTM Vol.7, Springer Verlag 1973.

3. Tom M. Apostol. ,Introduction to Analytic number theory

Narosa Publishing house 1980.

4. I. Niven and Zuckerman, An Introduction to the Theory of Numbers, 4th Ed Wiley, New York,1980,

5. Rosen K.H., Elementary Number Theory and its Applications Pearson Addision Wesely, 5th Edition.

MTU-205(A): Differential Equations

(Maximum Number of Periods: 60)

Prerequistes :-The second order homogeneous equation, initial value problems, Linear dependence and independence,A formula for the Wronskian, The homogeneous equation of order n, The non-homogeneous equation of order n.

Unit 1:-

Initial value problem, solution of the homogeneous equation, Wronskian and linear independence, The Legendre equation, Non-homogeneous equation,The Euler equation, second order equation with regular singular points, The Bessel equation.

Unit 2:-

Equations with variables separated, exact equation, The method of successive approximations, The Lipschitz condition, approximations to and uniqueness of the solutions.

Unit 3:-

Some special equation, complex n-dimensional space, existence and uniqueness of solution to systems, existence and uniqueness of solution for linear systems.

Unit 4:-

First order PDE, Linear equations of first order, Charpit's method, Jacobi method, Quasi-linear equations.

Unit 5:-

Classification of second order PDE, one dimensional wave equation, Laplace equation, Theory of Green's function for Laplace equation, Heat condensation problem, Duhamel's principle.

Textbooks:-

1] E.A.Coddington:"An Introduction to Ordinary Differential Equation",
Prentice-Hall of India Pvt.Ltd.New Delhi.
Scope-chapter 1 to 6
2]T.Amarnath:"An elementary course in PDE"(2^{nd} edition), Narosa Publishing House.
Scope-chapter 1,2

Reference Books:-

1]G.F.Simmons:"Differential Equations with Applications and Historical Notes",
(2^{nd} edition)Mc Graw Hill Book Co.
2]W.E.Williams:"Partial Differential Equations",Claredon Press Oxford.
3] G.Birkhoff and G.C.Rota:"Ordinary Differential Equations",John Wiley and Sons.
4]E.T.Copson:"Partial Differential Equations", Cambridge University Press.
5]I.N.Sneddon:"Elements of Partial Differential Equation", Mc Graw Hill Book Co.